In an age which demands the training of large numbers of new investigators in the biomedical sciences, Burnet's assertions that no one can do effective research unless he enthusiastically enjoys it and that research is essentially intellectual play, to be equated with an organized sport, and imbued with a competitive spirit, are timely. His view that no great discovery in the experimental sciences is ever made more than a year before its discovery is inevitable is probably correct, and young scientists probably do have nightmares in which the specialized fields in which they are being trained, or in which they have learned to excel, wither away.

One cannot escape the conclusion, however, that some of Burnet's gloomy thoughts are the outcome of too many years away from the laboratory bench. Is much current research really without bearing on the progress of medicine or on the development of knowledge? And has laboratory research really fulfilled its major function? Active scientists will be unable to accept the statement that laboratory research in biology will cease to provide new concepts and that we are merely "waiting for the end" in most of the great inquiries of biology and medicine. Most would accept Burnet's view that biology of man himself, in those aspects that are uniquely human—his behavior, his genetics, the processes that determine growth, individual differences, and the nature of aging and death—is a new world for scientific conquest.

It is disappointing that Burnet reveals little about how he functions. He confesses to a lifelong uncontrollable urge to theorize and generalize and admits that he has very little interest in anyone else's theorizing upon a subject that interests him. However, he does not tell us how he manages to keep up with the information explosion on such a broad front, how he stores and retrieves the facts he draws upon with such facility, or how he plies his craft as a writer so productively.

This book will be of interest to microbiologists, immunologists, epidemiologists, oncologists, and even molecular biologists. Moreover, it reads so easily that at least one person found it to be a delightful biologist's book at bedtime.

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Diabetes

Pathogenesis of Diabetes Mellitus. Proceedings of a symposium, Stockholm, Sept. 1969. EROL CERASI and ROLF LUFT, Eds. Almqvist and Wiksell, Stockholm, and Wiley, New York, 1970. 354 pp., illus. $31.50. Nobel Symposium 13.

Unlike most volumes resulting from symposia, this collection of 12 contributions essentially covers the current knowledge of its subject in a very even and integrated manner. As valuable as the papers themselves are the carefully edited discussion following each presentation, most of which include data yet to be published or frank opinions and speculations put forward by the participants, among whom were not only some of the world's leaders in diabetes research such as Berson, Kipnis, Lacy, Levine, Taylor, Siperstein, Randle, and Steiner but also non-diabetes-oriented scientists like Sutherland, Changeux, Hechter, Krebs, and Tomkins.

The separate chapters start with Cerasi and Luft, editors of the volume, summarizing their data correlating diabetes with a delayed secretion of insulin following a glucose load. Presented are data, mainly from studies on identical twins, showing that this delay is inherited and suggesting that the primary lesion is related to the cyclic adenosine monophosphate system in the beta cell, since theophylline, a phosphodiesterase inhibitor, is capable of accelerating the delayed secretion toward normal. Chapters by Kipnis, Lacy, Taylor and Montague, Steiner *et al.*, and Renold *et al.* summarize what is known of the beta cell, its metabolism, and its various stimulating factors. Much attention is directed, and justifiably so, to how glucose itself stimulates insulin release. Again the discussions are as important as the presentations—for example, Randle's comment (p. 271) that concentrations of glucose-6-phosphate may rise 15-fold in mouse islets in the presence of high amounts of glucose, a finding that supports the view that glucose phosphorylation has an operationally high K_m. Also, the essential role of Ca^{++} in the release mechanism is emphasized in several discussions.

In other chapters Renold reviews the various experimental animal models, and Steinberg and his colleagues, using recent studies on the American Pima Indian, defend his hypothesis that diabetes in man may result from an autosomal recessive gene, the homozygous individual being susceptible to the disease. A bimodal distribution of glucose tolerance in the Pimas supports the hypothesis, and a mathematical defense (far beyond the comprehension of this reviewer) is presented in evidence.

Other fascinating bits of information are scattered throughout the volume, such as the bizarre spontaneous elevations of growth hormone concentration in the diabetic noted by Lundbaek (pp. 305–06), the micrographs of the beta cell granules made by Orci in Renold's laboratory using freeze-etched material, and Krebs's argument that the quinolinate inhibition of gluconeogenesis, as noted by Lardy, may have physiologic meaning. The chapter by Lardy on gluconeogenesis and that by Randle on glucose homeostasis are most current, contain the principal references, and are superb reviews of the state of the art, and yet are brief and succinct. Finally, the discussion between Siperstein and Lundbaek summarizes the pros and cons of the hypothesis that the vascular basement membrane is an independent expression of the inherited disorder rather than a secondary result of the abnormal insulin and carbohydrate metabolism.

The volume ends with "reflections," each several pages in length, by several of the participants. These are somewhat repetitive of the preceding chapters, but are nevertheless of some interest and use.

This reviewer's overall assessment is evidenced by the fact that he is recommending that several copies of the volume be placed on the reserve shelf in his university library as a standard reference for undergraduates and postgraduates in endocrinology, metabolism, pathology, and internal medicine.

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Biological Messages

Communication in Development. Twenty-eighth symposium, Society for Developmental Biology, Boulder, Colo., June 1969. ANTON LANG, Ed. Academic Press, New York, 1970. xii, 272 pp., illus. $12. *Developmental Biology*, Supplement 3.

The orderly development of an organism and the coherent responses an organism makes to a changing environment require precise coordination between the elements and processes that

constitute the organism. This is beautifully illustrated in a description in this volume of the fate of the diapausing pupa of the silkworm when given an overdose of molting hormone. Metamorphosis is accelerated and cuticle deposition outstrips other processes until the reorganizing elements which should form the adult moth are frozen in place and a nonviable monster is produced. Elsewhere in the volume we are entertained with fact and theory about the emergence of order from a prebiotic soup, the coordinated synthesis of macromolecules during bacterial growth, interplay between domains in single plant and animal cells, chemical communication between cells by means of all types of chemical messengers, and finally environmental cues eliciting developmental responses.

There are several lessons to be extracted. One is that although differential gene action may set the direction and boundary conditions for developmental processes, many or most of the steps involved in coordination of these processes operate at other levels. Several of the contributors dwell upon the immediate steps in communication, particularly reception and primary processing of messages. Another lesson is that the messenger (word, hormone) can often be arbitrarily chosen, the meaning of the message being determined by the rules of syntax of the language, and we can understand the choice of messenger only by considering the history of the language. The history of biological communication is a part of evolution. Thus we must imagine "phylogenetic trees" for communications systems. From this point of view we might expect important differences between *E. coli* and elephants.

This volume will be useful to teachers and graduate students and to developmental biologists who want to know the gist of what is happening in other sectors of their multidisciplinary field. It might even serve as the foundation for a graduate seminar course, but as such it would have its shortcomings. Coverage of this broad a subject is unavoidably spotty. Furthermore, unifying principles of communication phenomena do not spring from the individual contributions. Although the editor supplies some interpretation and overview in an epilogue, the volume begs for more. Thus, to create a coherent seminar course would require judicious supplementation and a great deal of thinking. (One might argue that this is a hidden asset.) On the positive side, the volume offers a refreshing perspective on development and leaves the notion that a deeper understanding of developmental processes will issue from this line of thought.

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Marine Techniques

In-Water Photography. Theory and Practice. LAWRENCE E. MERTENS. Wiley-Interscience, New York, 1970. xviii, 392 pp. + plates. $19.95. Series on Photographic Science and Technology and the Graphic Arts.

Advanced techniques in most professions are a mix of art and science. Although several excellent books are available on the art and purpose of photography in the water, this book is unique and welcome because it emphasizes theoretical and practical aspects. The author's technically correct choice of "in-water photography" as the title rather than the more familiar but inexact "underwater photography" properly sets the analytical tone of the book.

The nearly 400 pages of this book contain a well-balanced combination of text, equations, curves, pictures, and references. It should therefore be readable and useful both to serious amateurs and to professionals, whether users or designers. Chapters are devoted to light transmission, contrast, filters, supplemental lighting, lenses and optical ports, cameras and housing, films and image tubes, biological effects, systems and application, new photographic techniques, and diving techniques. The individual chapters, with their somewhat textbook-like format, have considerable breadth and provide considerable information in each of the subfields. The legibility of print, of the line drawings, and of most of the figures is excellent.

This reviewer was impressed by the compilation of so much pertinent information between two covers. Reading this book, and particularly those chapters that deal quantitatively with the optical problems, should upgrade the understanding and work of "in-water" photographers and designers.

In sections devoted to equipment and suggested field techniques different readers might choose somewhat different examples or procedures, but such points are debatable, and criticisms that might be made are certainly minor in relation to the overall presentation of typical problems and a rationale for their solution. The author is on his firmest ground when dealing with optical problems, which he does well indeed. The price of the book may seem high for an individual photographer but is commensurate with the cost of specialized photography.

Photography in the water has long needed a comprehensive book devoted to the technical and optical aspects of the problem. This is such a book and should be a welcome addition to the libraries of all who are seriously interested in the subject.

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Extending the pH Scale

Acidity Functions. COLIN H. ROCHESTER. Academic Press, New York, 1970. x, 300 pp., illus. $13. Organic Chemistry, No. 13.

Since the original work by L. P. Hammett and A. J. Deyrup in 1932, acidity functions have been used with ever-increasing sophistication to extend the aqueous *p*H scale empirically well beyond the limits set by dilute aqueous solutions. It has thus been possible to measure the strength of very weak acids and bases, to interpret the kinetics of catalyzed reactions in super-acid or super-basic media, and to infer reaction mechanisms and modes of proton transfer. The literature on acidity functions is vast, and there have been important changes in point of view since the publication, in 1957, of the classic review by F. A. Long and M. A. Paul.

The present book by Colin H. Rochester is a well-organized, comprehensive, up-to-date review of the subject. It begins with a brief chapter on the theory of *p*H and acidity functions. Then there are two chapters, unique in their completeness, and with many tables of data, about the Hammett acidity function and about acidity functions for solutes other than neutral Hammett bases. These are followed by lucid chapters on acidity functions in acid-catalyzed reactions, in nonaqueous and mixed solvents, and for concentrated solutions of bases. Throughout the book, the discussion is essentially impartial: Where different laboratories